L1B Readiness, Update Plans and Stability of Product

Outline

- **L1B Readiness**
- **Product stability**
- **Plans for L1B Updates to Launch + 7 months**
- **Items you need to know**
- **Background charts**
  - File format description
  - L1B V2.1.5 performance metrics
  - Versioning convention **(new)**
  - Improvement features for each delivered version

L1B Readiness

- **Level 1B code status**
- **Enhancements for May 30 delivery**
- Unit testing through End-to-End Testing
- **L1B delivery history**
  - Report card for I&T processes from SDST/DAAC for recent deliveries
- **Plans for enhancements up to launch**
- **Computer Resources of MCST (CROM) status and plans**

Level 1B Code Status

- **Level 1B development follows an evolutionary life cycle model.**
- **Latest version running at the DAAC (2.1.5) implements all the science algorithms defined for the March 1, 1999 delivery.**
- **Algorithm changes have imposed new requirements on the Level 1B code for the May 30, 1999 delivery Summarized on the next page. Coding of new requirements is approximately 25% complete.**

Enhancements for the May 30, 1999 Delivery of Level 1B - I

- **Implement a common algorithm for TEB and RSB for computing background DN using 3-sigma outlier rejection:**
  - TEB retains ADC correction option.
  - RSB transitions to BB DNs if the moon is in the space-view port.
  - Only major architectural change
- **Write additional data to the OBC file needed for Solar Diffuser and SRCA cross-granule analysis.**

Enhancements for the May 30, 1999 Delivery of Level 1B - II

- Implement changes to RSB reflectance and radiance calibration scales to use common values over a whole granule.
- Add usage of RSB detector saturation tables.
- Implement RSB uncertainty algorithm.
- Change TEB LUTs for calibration parameters.
- Implement refined TEB uncertainty algorithm.
- Implement QA refinements for both RSB and TEB.
- Implement fixes for minor code defects.
- Add Band 26 SDS

L1B Testing

- **Unit level (MCST)**
  - each function broken out into a unit test directory.
  - unit test drivers define input data and subordinate functions (usually stub functions).
- **Component level (MCST)**
  - major modules tested similar to units except that subordinate functions are fully tested units.
  - input data derived from simulated L1A data provided by SDST or created manually.
- **CSCI level (MCST)**
  - Entire L1B code run using simulated L1A data provided by SDST.
- **End-to-End (ETE) level (SDST, DAAC)**
  - L1B run within SDST and at DAAC to test ETE functionality.
  - These tests use old releaser v2.0
  - Support S/C ETE in May

L1B Delivery History

(MCST)	Version	Implementation	Date
	2.0	Functional S/W system to support post-launch processing	10/97
	2.1	Incorporate algorithm changes from analysis of PFM data	4/98
	2.1.1	Emphasis on maintainability, resolve open metadata items	2/26/99
	2.1.5	Fixed defects in 2.1.1. Provided more realistic LUTs.	4/26/99
(3.0.0.0)	*2.2*	*At-launch version, best physics Incorporated.*	*5/30/99*

- All deliveries have been made on schedule
- MCST Deliveries to SDST have had minimum turnaround for delivery to DAAC on order of 1 working day

L1B Testing Beyond May 30

- **End-to-End (ETE) level (SDST, DAAC)**
  - L1B run within SDST and at DAAC to test ETE functionality.
  - These tests use old release v2.0
  - Further ETE tests will be supported
- **Unit, component and CSCI tests will be continued, as necessary, whenever code changes are made.**
- **Difference methods (comparing old output with new output) for LUT changes will be employed to catch LUT input errors.**
- **Science-level testing with MCST generated data sets**

Plans for Enhancements up to Launch

- Incorporate elements on list for May 30 delivery which did not get completed
- Revised RSB flat-fielding approaches
- Add few new LUTs
- No significant changes to architecture can be supported and still have L1B launch-ready for July 15 or 28 launch date

Computer Resources of MCST (CROM)

- 88 GB per day of processed and unprocessed data (approximately 20%, including duplicate formats, of the total data stream) from the DAAC to support analysis operations.
- Delivered via a T-3 line; installation scheduled late May.
- Capacity process data from EDS Level 0 through L1B, primarily on 4-processor Alphaserver. Final hardware configuration is under way now for this system.
- Algorithms to process data through L1A and L1B have been delivered by SDST and MCST. These algorithms are now being ported. The porting effort is behind schedule, but is expected to be completed by May 31.
- Software to automate local processing of data from L0 to L1B is under development now. Delivery of complete version is scheduled for May 31. Software development is on target to satisfy this schedule.

Product Stability

- **Period L + 34 days to L + 49 days: Unstable/unofficial, using pre-launch calibration values only**
- **Period L + 50 days to L + 65 days: Install on-orbit calibration look-up tables**
- **First L1B Validation Workshop at L + 130 days. Beginning at L + 145 days: Official L1B Operations**
  - Reprocess preceding data segments as required by MODIS Science Team
- **L + 145 to L + 7 months: Update per Operational Activities, Vicarious Activities and Characterization Activities as required (small changes as approach native instrument potential)**
  - Reprocess preceding data segments as required by MODIS Science Team
- **2nd Calibration Validation Workshop at L + 7 months**

Plans for L1B Updates to Launch + 7 Months

- **MCST most likely scenario for L1B code**
- **Estimated most likely L1B update scenario**
  - Rapid response critical changes as needed
  - Moderate/low impact changes accumulated and incorporated monthly through A&E
  - Frequent LUT updates following MCST validated program outputs
- **Remove Band 26 SDS unless told no (L+120)**
- **Plan to reprocess all of first 130 days of L1B data following Validation Workshop**
- **Scene Contrast Scatter Index not scheduled for implementation**

Items (we believe) you need to know

- **Non-intuitive aspects of Level 1B File Format**
- **Uncertainty index strategy (see Miami '99 charts)**
- **Scene contrast index - not implemented**
  - Product and uncertainties correspond to flat scenes only

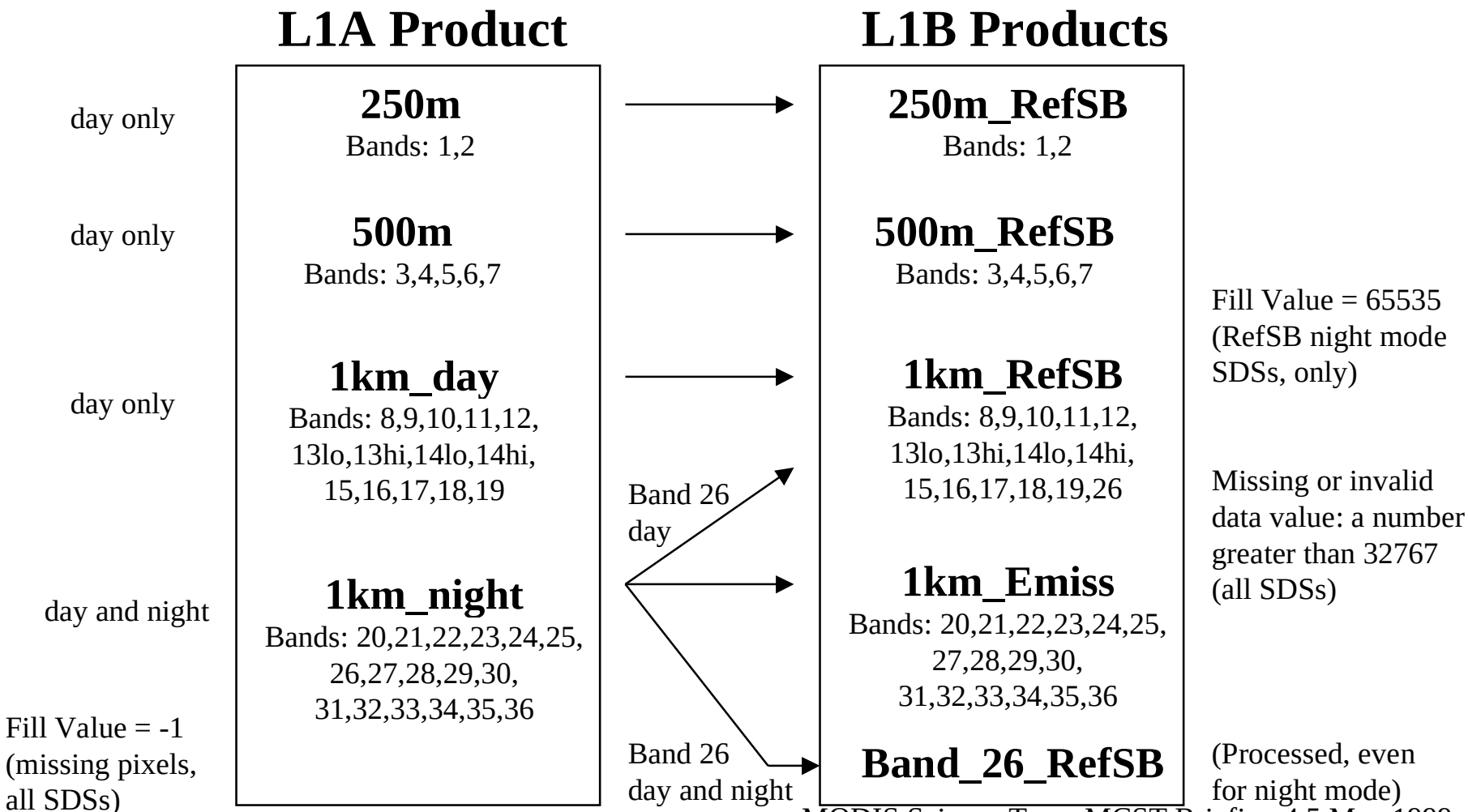
Non-intuitive Aspects of Data Product: Data Earth-registered within Packets

- **Bands in data packets are Earth-registered**
- **Actual data acquisition separated by distance across FPA, and is not Earth-registered**
- **Maximum separation is Band 32 to Band 30 which is 29 frames**
- ***ALL* spectral and spatial corrections (SWIR leaks, B31 ➡ B32-B36, etc) must be based on contemporaneous data acquisitions and must be adjusted for on-board data ordering for co-registration**

Non-intuitive Aspects of File Format Detector Ordering within Band

- **Detector numbers assigned by hardware engineers are reverse of data storage numbers in level 1B**
  - Allows indexing of lines of data within a scan to increase from 1 to 10, 20, or 40, in increasing along-track direction
- **Level 1A reverses detector order sent down in telemetry stream**
- **Indexing of detectors within band in SBRS documentation not consistent with L1B**

Relationship Between L1A Product Band Groupings and L1B Groupings



Non-intuitive Aspects of File Format Reflective Solar Band Data at 1 km Resolution

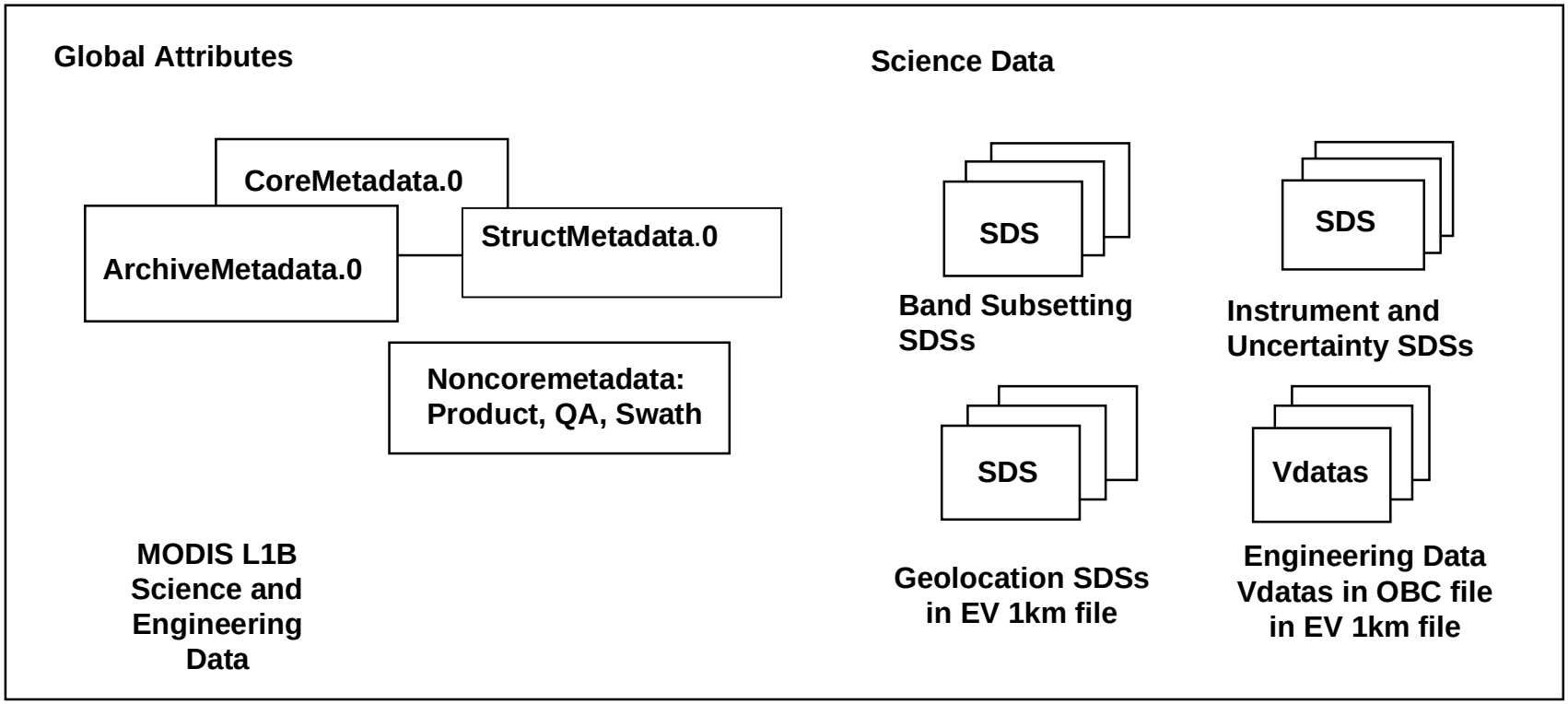
- **Sequence in which the 1 km Reflective Solar Bands are written to level 1B products**
  - TDI Bands 13lo, 13hi, 14lo, 14hi treated as separate bands
  - Band names follow sequence “8,9, . . ., 13lo, 13 hi, 14lo, 14 hi, 15,…,19,26”
  - 1km RSB band numbers follow sequence 8,9,…,13,13.5,14.0,14.5,…19,26
- **Band N (N=15...19, 26) found other than where you would expect to find them in SDS**
- **Existing SDST readers incorporate this feature now**

Non-intuitive Aspects of File Format Storage of Band 26 Data

- **Reflective Band data in night mode stored as fill values = 65535 BUT**
- **Band 26 is a reflective band but data returned even at night**
  - data are in a separate SDS written for day and night mode
  - day mode data duplicated in 1 km RSB SDS
  - Band 26 separate SDS will be removed at launch+120 days unless requested otherwise by Science Team

Back-up Charts for L1B software

L1B Product Format: HDF*-EOS**



***Hierarchical Data Format (HDF), National Center for Supercomputing Applications (NCSA), University of Illinois, Champaign, Illinois.**
****HDF-EOS Primer for Version 1 EOSDIS. 175-WP-001-001. White Paper, Hughes Applied Information Systems, April 1995**

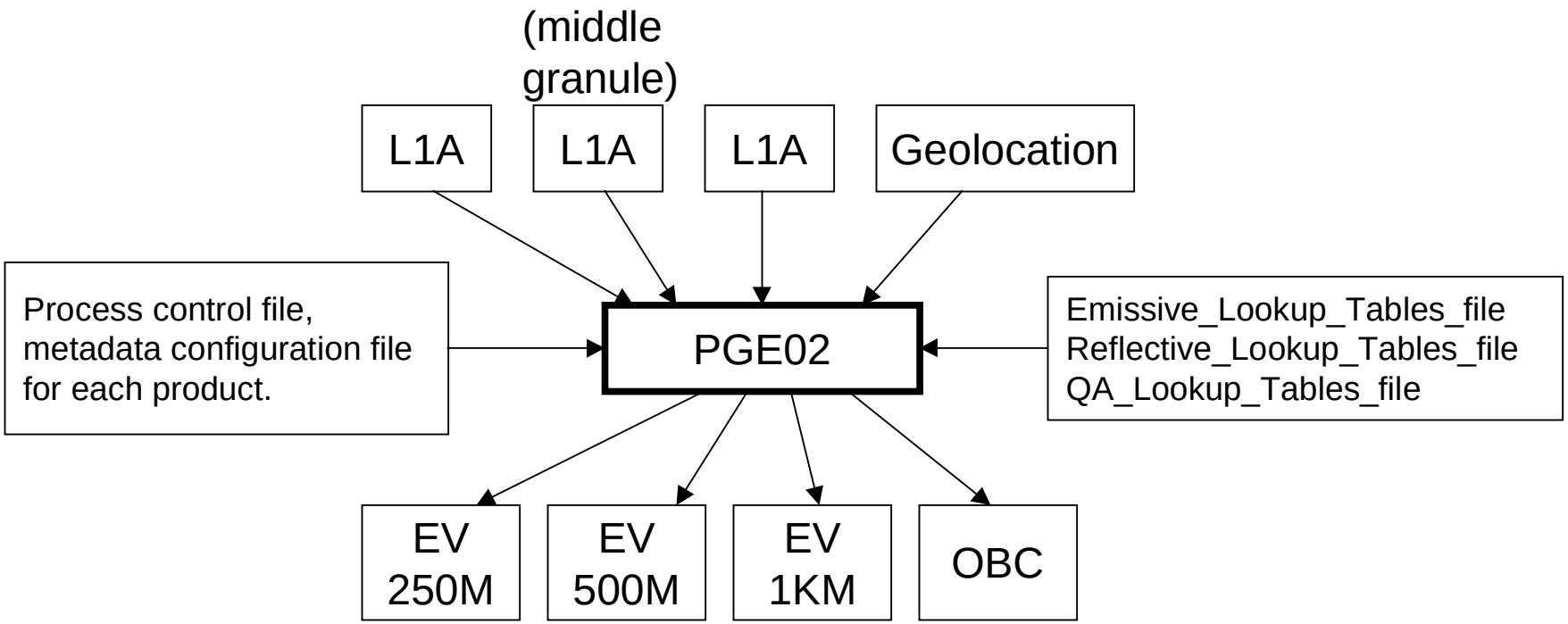
Global Attributes, Summary

- **Core metadata** provide granule level information for ingesting, cataloging, and searching data products.
- **Archive metadata** provide granule-level data which are not written to the searchable database.
- **Product metadata** satisfy requirement to track MODIS specific data at the granule level.
- **QA Metadata** provide the information needed at the granule level to track the quality of the calibration.
- **HDF-EOS Swath Metadata** are dimension metadata stored as a global attribute "StructMetadata.0". These are not accessed by the user.
- **L1B Product User's Guide (PUG)** will contain more detailed information. Delivery date: June 21, 1999

Instrument and Uncertainty SDSs

- **1 km Earth View file**:
  - reflected solar band calibrated data at 250 m resolution aggregated to 1 km,
  - reflected solar band calibrated data at 500 m resolution aggregated to 1 km,
  - reflected solar band calibrated data at 1 km resolution,
  - emissive thermal band calibrated data at 1 km resolution,
  - uncertainty indices for the all four sets of calibrated data,
  - number of samples used in the aggregations.
- **500 m Earth View file**:
  - reflected solar band calibrated data at 250 m resolution aggregated to 500 m,
  - reflected solar band calibrated data at 500 m resolution,
  - uncertainty indices for both sets of calibrated data,
  - number of samples used in the aggregations.
- **250 m Earth View file**:
  - reflected solar band calibrated data at 250 m
  - uncertainty indices for the calibrated data.

L1B In-Granule Data Flow



(L1B granules correspond to middle L1A granule)

Typical L1B Product Volumes

	Day Mode	Night Mode
Input volume		
L1A granules	3 x 537 MB	3 x 178 MB
Geolocation	58 MB	58 MB
Output Volume		
250m granule	273 MB	21 MB
500m granule	262 MB	21 MB
1km granule	319 MB	128 MB
OBC file	54 MB	54 MB

PGE02 Current Code Metrics (V2.1.5)

Language: C
Uses libraries:
HDF
HDF-EOS
Uses PGS Toolkit

# code functions	112
# code lines*	16.3 K
Typical CPU**	
SG Indigo	32.5 min.
SG Octane	14.2 min.
RAM	114 MB

* includes both comments and source, header and code
** 203-scan day mode. Night mode runs are a few minutes less.

MCST Level 1B Versioning Strategy

- **The new format VA.B.C.D, where**
  - A is an integer that is incremented for file spec changes,
  - B is an integer that is incremented for major science changes,
  - C is an integer that is incremented for minor science changes or code bug fixes which affect the science data products, and
  - D is an integer that is incremented for any lookup table (LUT) change.
- **Location: Standard Archive Metadata:**
  - ALGORITHMPACKAGEVERSION (a character string)
- **May 30 Delivery**:
  - Version “3.0.0.0” (PGE02 version 2.2)

Procedures for Updating

- **A (file spec changes)**
  - *Any* change in number of data sets or content of data sets will result in an increment. (Excludes minor changes to a description or wording within the file spec).
- **B and C: (Science/code changes)**
  - MCST Project Manager decides when a code change warrants either of these.
- **D (LUT change)**
  - Any change to Reflective, Emissive or QA LUTs.
- **Resetting digits to zero:**
  - Procedures under review, considering reprocessing implications

Additional LUT Version

- **Digit "D" identifies if any LUT changed in any of the LUT files. Additionally, each LUT file contains a serial number and date of last change. These are written to the L1B products as global attributes:**
  - Reflective LUT Serial Number and Date of Last Change
  - Emissive LUT Serial Number and Date of Last Change
  - QA LUT Serial Number and Date of Last Change
- **Additional information on each LUT (including a change history) will be placed on the MCST web site:**
  - http://mcstweb.gsfc.nasa.gov